DEPARTMENT OF TRANSPORTATION
ENGINEERING SERVICE CENTER
Transportation Laboratory
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UNCONFINED COMPRESSIVE STRENGTH OF SOIL

CAUTION: Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read **"SAFETY AND HEALTH"** in Section H of this method. It is the responsibility of the user of this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed.

A. SCOPE

The unconfined compression test is used to measure the shearing resistance of cohesive soils which may be undisturbed or remolded specimens. An axial load is applied using either strain-control or stress-control condition. The unconfined compressive strength is defined as the maximum unit stress obtained within the first 20% strain.

B. APPARATUS

The compression device is a hydraulic-actuated loading piston, electronically controlled, with the capability of infinite rates of strain and stress loads. A load cell of 44.5 kN or 222.5 kN capacity is fastened to the piston to measure load on specimen. Test data are displayed on control panel board readouts. See Figure 1 for compression device and Figure 2 for specimen holder.

C. TEST RECORD FORM

Record test data on worksheet Form TL-265 (Figure 4). After test and calculations are completed, summarize test results on Form No. TL-239.

D. PREPARATION OF SAMPLE

1. No special trimming is required when specimens obtained with the California sampler are used in this test. Extrude the soil from the 101.6 mm high sample retainer in which it is received by pushing it in same direction it entered the tube, and then place sample directly into position on the loading device.

2. Trim soil which is received in a Shelby tube or a block sample to a 38.1 mm x 38.1 mm x 76.2 mm rectangular block specimen for testing, and do the trimming with the sample trimmer similar to the one shown in Figure 3.

3. Begin test immediately after the specimen is removed from the tube as drying will alter its characteristics considerably.

FIGURE 1

FIGURE 2

E. TESTING PROCEDURE USING CONTROLLED STRAIN

Place specimen on base of holder, Figure 2, and set holder on compression device. Lower loading piston until it contacts specimen push rod. Contact will be noted by slight reading on load readout gauge. Zero out readout gauge, check strain rate setting, and begin test. Continue test until load values decrease or until 20% strain is reached. Make a moisture determination and also a sketch of specimen showing failure conditions such as slope angle, if measurable. Obtain classification tests as needed.

F. CALCULATIONS

The following data are necessary for a complete test:

1. The boring samples and tube numbers.
2. A complete description of the specimen.
3. The moisture content.
4. The maximum load and the deflection due to that load.

The unconfined compressive strength is computed from the following formula:

$$qu = (P/A)(1-[\Delta H/H])$$

Where:

qu = The unconfined compressive strength in kPa

P = Maximum load in kN.

A = Initial cross-sectional area of test specimen in square millimeters.

H = Initial height of test specimen.

ΔH = Reduction in height of test specimen.

$1 - (\Delta H/H)$ = Correction for increased area assuming constant volume.

G. NOTES

The unconfined compression test is usually made on undisturbed samples. It is reasonably simple and rapid to perform. It gives a very good measure of the shearing strength of cohesive soils. In somewhat granular soil its application is limited, but it does provide a good supplementary test for more complex strength tests.

The unconfined compression test is limited in that test conditions can be varied very little. Hence, the test may provide a good measure of the in-situ strength, but may provide only limited strength data, as the stress conditions change due to loading or construction.

H. SAFETY AND HEALTH

Prior to handling, testing or disposing of any waste materials, testers are required to read: Part A (Section 5.0), Part B (Sections: 5.0, 6.0 and 10.0) and Part C (Section 1.0) of Caltrans' Laboratory Safety Manual.

Users of this method do so at their own risk.

End of Text (4 Pages) on California Test 221

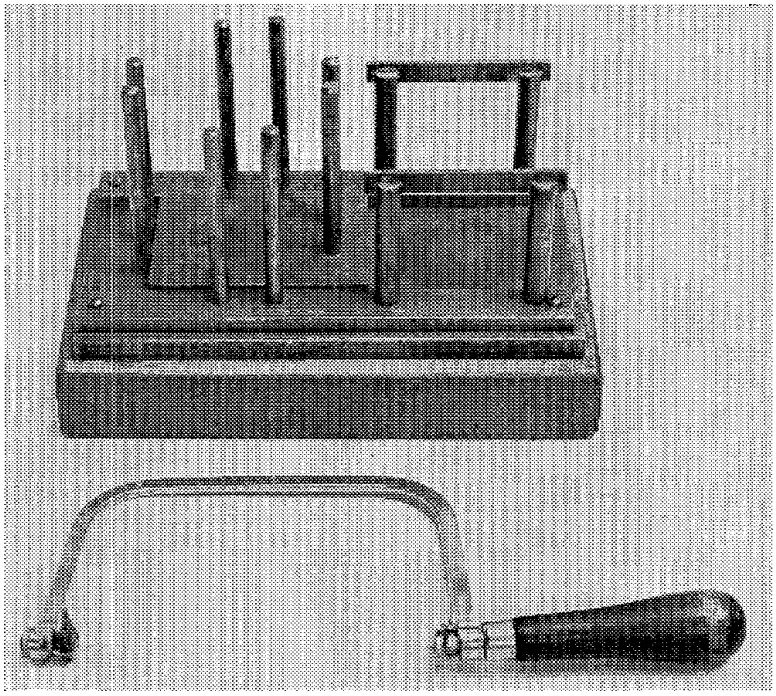


FIGURE 3

California Test 221
1978

UNCONFINED COMPRESSION TEST
TRANSPORTATION LABORATORY

Date_____ Test by _____ Chamber No._____ Transd. No._____ Sta. No._____

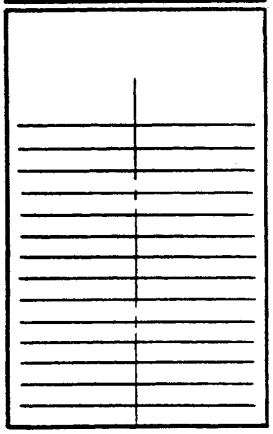
% Compaction _____ Target Moist._____ Strain Rate _____.04_____ in/min._____

Job Name _____ Nominal Ht. _____4_____ Wet Wt. before _____
Job No. _____ Initial Height _____ Dry Wt. after _____
Sample No. _____ Initial Diam. _____ Specific Gravity _____
Specimen No. _____ Proving Ring No. _____

% Strain	Dial Reading	Calc. Time	Actual Time	Axial Load
0	0			
1/4	.010	15 sec.		
1/2	.020	30		
3/4	.030	45		
1	.040	1 min.		
1-1/2	.060	1-1/2		
2	.080	2		
2-1/2	.100	2-1/2		
3	.120	3		
3-1/2	.140	3-1/2		
4	.160	4		
4-1/2	.180	4-1/2		
5	.200	5		
6	.240	6		
7	.280	7		
8	.320	8		
9	.360	9		
10	.400	10		
12	.480	12		
14	.560	14		
16	.640	16		
18	.720	18		
20	.800	20		

3E33

A. T. Moist. _____ %



M. A.☐ Sp. G.☐
Atter.☐
Other Tests _____

Moisture: Dry___Moist.___ Wet ___Free Water ____

Structure: Homo ☐ Hetero ☐ Band ☐ Strat ☐ Lamin ☐ Lenses ☐ Cement ☐ Fiss ☐
Calc ☐ Mott ☐ Roots ☐ Voids ☐ Others ☐ HCL Reaction _____

Consistency: Very soft___Soft ___ Firm___Stiff___Hard ___ Rock ___

Visual Class _____ Color _____
Remarks: _____

TL-265 D(Rev. 9/75)

FIGURE 4